QuikSCAT Geophysical Model function and Winds for Tropical Cyclones

Simon H. Yueh, Bryan Stiles, and W. T. Liu
Jet Propulsion Laboratory, MS 300-235
California Institute of Technology
4800 Oak Grove Drive, Pasadena, CA 91109, USA
Tel: 818.354.3012, Fax: 818.393.3077
E-mail: simon.yueh@jpl.nasa.gov

Abstract –The QuikSCAT scatterometer has been operating since August 1999 to provide global mapping of ocean winds. The ocean surface winds from the QuikSCAT scatterometer are accurate, except for precipitating and extreme high wind conditions. It is known that the QuikSCAT scatterometer winds typically underestimate the strength of tropical cyclones and overestimate the wind speed for low to moderate wind speeds (3-10 m/s) under rainy conditions. Our previous analysis of the QuikSCAT data from 1999 for several hurricanes in the Atlantic and eastern Pacific indicates that the normalized radar cross-sections (sigma0s) of sea surfaces measured by the QuikSCAT increase with wind speed for up to about 50 m/s wind speed, and the wind speed sensitivity of sigma0 sensitivity decreases with rain rate. However, the 1999 data set was not large enough to assess the wind direction sensitivity of sigma0s. The analysis of three years of collocated QuikSCAT sigma0, QuikSCAT brightness temperature, and SSM/I rain rate data from 1999-2001 was performed to examine the influence of wind direction. The results show that the QuikSCAT sigma0s have a small wind direction modulation of ~1 dB at 40 m/s wind speed, and the amplitude of modulation decreases with wind speed. The observed wind direction signature of sigma0s at high wind speeds has been used to generate a revised geophysical model function for QuikSCAT. We explored two microwave rain models to account for the attenuation and scattering effects of rain. One is derived from the collocated QuikSCAT and SSM/I data set, and the other one is a published parametric model for rain radars. The revised geophysical model function has been used to retrieve the ocean wind vectors for several tropical cyclones from the collocated QuikSCAT and SSM/I rain rate data, and the resulting intensity estimates of these tropical cyclones show improved agreement with the best track analysis from the National Hurricane Center.